SYSTEM AND METHOD FOR MONITORING THE LIGHT LEVEL IN A LIGHTED AREA

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a Continuation-In-Part of U.S. Patent Application Serial Number 09/412,895, filed October 5, 1999, which was a continuation in part of U.S. Patent Application Serial Number 09/172,554, filed on October 14, 1998 (now U.S. Patent 6,028,522, issued February 22, 2000).

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention generally relates to lighting systems, and more particularly to a system for measuring the light level in a lighted area.

DESCRIPTION OF RELATED ART

As is known, nighttime is often an opportune time for a would-be thief to rob a person, especially when there is a low level of light in the lighted area. The reason that it is easier for the would-be thief to not be recognized during nighttime and when the level of light in the lighted area is low. Hence, a combination of nighttime and a low level of lighting exposes people and leaves them extremely vulnerable to a would-be thief.

To address the security issue, some states require that certain minimum lighting standards be maintained in lighted areas. In this regard, several states have already passed legislation that mandates certain minimum lighting level conditions in an area surrounding ATM devices, and similar legislation is pending in other states. For

example, House Bill 5298 of the Massachusetts House of Representatives proposes a comprehensive ATM physical security proposal, which specifies minimum lighting specifications at an ATM location.

Furthermore, with many state Legislative Acts now requiring proper operation of lighting systems, e.g., mandating penalties for failure to sustain adequate lighting the need becomes ever greater that such lighting systems be maintained in proper working order at all times. One way to achieve this is to provide excess lighting in an area, so that if one or more lights burn out, adequate lighting is still maintained. This generally affords the service personnel enough time to detect and repair any faulty lights before the overall lighting, conditions fall below specifications. Another way that some utility companies maintain adequate lighting is that every time the level of light in the lighted area falls below a certain level, they send their personnel to change the lights. However, there is an inconvenience of sending the personnel to change the lights every now and then. Therefore, the utility companies periodically change all of the lights in the lighted area because it is cheaper and more convenient than sending their personnel to change the lights frequently. Nevertheless, unfortunately all of these approaches impose undue time, effort, and costs for implementation.

Therefore to avoid undue time, effort, and costs for implementation, a lighting system may be used in lighted areas including but not limited to parking garages, buildings, residences, and streets. The lighting system is a solution to some utility companies such as the Southern Company sending their personnel every three to four years routinely to change all the street lights. The utility companies send their personnel on a periodic basis because it is more cost effective to send personnel periodically to

change all the lights than to send people out periodically just to replace one or two lights. Hence, the lighting system is illustrative of a number of other countless applications or areas or environments where it would be desirable to be able to measure and monitor lighting conditions without having to send people out periodically to just manually test, check or observe the lighting in a lighted area.

U.S. patent 5,774,052 to *Hamm et al.*, discloses a monitoring and alerting system for buildings. More particularly, the '052 patent describes a system that includes one or more light level sensors directed to observe the light level at a selected location. A CPU or controller stores data representing an acceptable light level for a given time schedule. If the light level at the selected area does not reach or maintain the desired light levels, corrective action is taken. By way of specific example, the '052 patent teaches that if the commercial establishment is a bank and the light level is at an ATM, the corrective action taken by the system may temporarily shut down the ATM and illuminate a sign to indicate that the ATM is not open. This would alert customers that they should use other ATM devices, and therefore the threat of theft is reduced. The system of the '052 patent also includes a modem in communication with the CPU to allow the transmission of certain data to a remote location. Specifically, the '052 patent states that "if the condition sensed is a different type of discrepancy, failure of heating, water leak detection, or other emergency, the system includes a modem and telephone communication link to a human monitoring station for instantaneous alerting and to allow corrective action." Such a system, however, requires a direct connection of a telephone line with the ATM device.

SUMMARY OF THE INVENTION

Certain objects, advantages and novel features of the invention will be set forth in part in the description that follows and in part will become apparent to those skilled in the art upon examination of the following or may be learned with the practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

To achieve the advantages and novel features, the present invention is generally directed to a system and method for monitoring the level of light in areas such as parking structures, buildings, residences, roads, and preferably the area surrounding an ATM. In accordance with one aspect of the invention, a system is provided for monitoring the level of light in an area having a plurality of light gauges disposed in varying locations around the lighted area, wherein each light gauge includes a light sensor, a central processing unit, a memory, and a radio frequency (RF) transmitter disposed to intercommunicate among each other. A first light gauge, of the plurality of the light gauges, is configured as a master light gauge, and the remainder of the plurality of light gauges are configured as slave gauges. Each of the slave light gauges may intercommunicate with the master light gauge via the RF transmitters. The master light gauge, however, further includes a telecommunications interface disposed in communication with the microprocessor. The telecommunications interface, which may include a cellular transmitter or a PSTN interface, is configured to communicate information relating to an output value of the photo-cells of the plurality of light gauges to a central station.

In addition, and in a preferred embodiment, each of the light gauges includes a unique identification code. Thus, in one configuration, the master unit may communicate the identification code of each slave unit to a central system for monitoring. It may also associate with each identification code the status value of the on-board light sensor of each gauge. In an alternative configuration, the master unit may communicate to the central system a single "ok" command to indicate that all light gauges at that area are receiving light levels at or above a specified value. In such an embodiment, the master light gauge may be configured to communicate only the identification number and light sensor status of light gauges that fall below a specified level. This will minimize the communications across the telecommunications link.

In accordance with another aspect of the invention, a system includes a plurality of light sensors disposed in varying locations around the area. Preferably, some sensors will be disposed near the lighted area, while others will be dispersed at various distances surrounding the lighted area, in order to effectively monitor the lighting around the area. A circuit is provided within the area in communication with the sensors. In addition, a radio frequency (RF) transmitter is disposed within the lighted area, and is configured to communicate the status of the sensors to a remotely located receiver. Finally, a receiver is interfaced to a telephone line forming part of a public switched telephone network (PSTN), wherein the receiver is configured to receive the status of the sensors communicated from the RF transmitter and to communicate the status information to a remote system via the PSTN.

In accordance with one embodiment of the present invention, the light monitoring system may be configured to operate only during certain hours, such as the hours that

coincide with darkness. Alternatively, the system may be configured to operate twenty four hours a day. Thus, during certain extremely cloudy conditions, the lights surrounding the area may be configured to illuminate. Failure of the lighting system to adequately illuminate the environment surrounding the lighted area would result in the inventive system alerting a remote system to dispatch service personnel to repair or otherwise troubleshoot and repair the system. The preferred embodiment may further include a sensor for determining the proper operation of a security camera used to monitor the vicinity of the ATM. If the security camera is determined to malfunction, then this condition may also be reported to the remote system so that appropriate service personnel may be dispatched to remedy the problem.

In accordance with another embodiment of the invention, a similar system is provided for monitoring the level of light surrounding an area. Like the previous embodiment, this embodiment of the invention includes a plurality of light sensors disposed in varying locations around the area, and a circuit within the area in communication with the sensors. However, this embodiment of the invention includes a cellular transmitter disposed within the area for communicating the status of the sensors to a remote cell site, the cellular transmitter being disposed in communication with the circuit. The cell site can then relay this information to the PSTN and on to a central system.

In accordance with yet another embodiment of the invention, a similar system is provided for monitoring the level of light surrounding an automatic teller machine (ATM). Like the previous embodiment, this embodiment of the invention includes a plurality of light sensors disposed in varying locations around the ATM, and a circuit

within the ATM in communication with the sensors. However, this embodiment of the invention includes a radio frequency (RF) transceiver disposed within the ATM configured to communicate the status of the sensors to a second, remotely located transceiver. A second transceiver is interfaced to a telephone line forming part of a public switched telephone network (PSTN), wherein the second transceiver is configured to receive a request via the PSTN initiated from a remotely located system to check the status of the light sensors and relay that request to the RF transceiver disposed within the ATM. The second transceiver is further configured to receive the status of the sensors communicated from the RF transceiver, the second transceiver is further configured to communicate the status information to a remote system via the PSTN.

In accordance with another aspect of the invention, a method is provided for monitoring lighting conditions surrounding an automatic teller machine. The method includes the steps of disposing a plurality of light sensors around the ATM and communicating the status of the light sensors from the sensors to a computer within the ATM. The method further includes the step of communicating the status of the light sensors from the ATM to a remote system via a public switched telephone network. In accordance with the preferred embodiment, the last step further includes the step of communicating the status of the light sensors via an RF transmitter from the ATM machine to a remote receiver.

The present invention, as highlighted above, realizes several advantages over prior art approaches and systems. One advantage realized by the system of the present invention relates to portability. In those embodiments that utilize either an RF transmitter

or a cellular transmitter, a physical phone line need not be connected to the ATM, and thus a readily portable ATM device may be provided.

Another advantage of the system of the present invention relates to flexibility. By including an identification code within the ATM (and/or within the light meter gauges) that is communicated to the central system, specific identification of malfunctioning lights and/or a service-needy ATM can be readily identified.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings incorporated in and forming a part of the specification, illustrate several aspects of the present invention, and together with the description serve to explain the principles of the invention. In the drawings:

FIG. 1 is a system-level block diagram illustrating differing embodiments and configurations of the present invention surrounding ATMs;

FIG. 2 is a block diagram of one embodiment of the present invention;

FIG. 3 is a block diagram of a second embodiment of the present invention;

FIG. 4A is a block diagram of a third embodiment of the present invention;

FIG. 4B is a block diagram illustrating a portion of a data packet that is communicated between an RF transmitter and a receiver in the embodiment of FIG. 4A;

FIG. 5 is a flowchart illustrating a top-level functional operation of an embodiment of the present invention;

FIG. 6 is a block diagram of an alternative embodiment of a system constructed in accordance with the present invention;

FIG. 7 is a block diagram of an alternative embodiment of a system constructed in accordance with the present invention;

FIG. 8 is a block diagram of an alternative embodiment of a system constructed in accordance with the present invention;

FIG. 9 is a system level diagram like that of FIG. 1, illustrating a system constructed from the embodiments illustrated in FIGS. 6, 7, and 8.

FIG. 10 is a system-level block diagram of an alternative embodiment of a system constructed in accordance with the present invention.

FIG. 11 is a block diagram illustrating a representative computer system utilized in a preferred embodiment of the present invention.

FIG. 12 is a partial, system-level block diagram of an alternative embodiment of a system constructed in accordance with the present invention.

FIG. 13 is a system-level block diagram of an alternative embodiment of a system constructed in accordance with the present invention.

FIG. 14 is a system-level block diagram of an alternative embodiment of a system constructed in accordance with the present invention.

FIG. 15 is a system-level block diagram of an alternative embodiment of a system constructed in accordance with the present invention.

FIG. 16 is a system-level block diagram of an alternative embodiment of a system constructed in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Having summarized the invention above, reference is now made in detail to the description of the invention as illustrated in the drawings. While the invention will be described in connection with these drawings, there is no intent to limit it to the embodiment or embodiments disclosed therein. On the contrary, the intent is to cover all alternatives, modifications and equivalents included within the spirit and scope of the invention as defined by the appended claims.

Turning now to the drawings, FIG. 1 shows a top-level block diagram of a light monitoring system constructed in accordance with the invention, and illustrates the interconnection between a cellular telephone system and a switched telephone network (PSTN). By way of background, the Federal Communications Commission (FCC) controls and regulates the cellular communication industry. In this role, it is responsible for granting licenses required to operate cellular systems. The FCC has divided the country into a number of geographic areas, and to encourage competition, the FCC has decreed that there be two telephone carriers in each geographical area. The FCC has further specified that one carrier must be a wire line, or standard telephone service provider, and the other must be a non-wire provider. Cellular carriers provide cellular systems for each geographical area licensed. The cellular systems serve to interconnect a cellular telephone subscriber with another cellular telephone subscriber or with standard telephones.

As shown in FIG. 1, there are three principal parts to a cellular telephone system: cellular subscriber stations (for cellular phones) 102 cellular base stations (or cell sites)

104, and a mobile telephone switching office (MTSO) 106. The subscriber stations 102 are typically standard portable or mobile telephones, each consisting of a standard transceiver, a handset, and antenna. Cellular base stations, or cell sites, 104 are typically dispersed geographically in a reasonably uniform fashion to get the maximum geographic coverage. The geographic region covered by a single cell site 104 is a called a cell. As is known and understood in the art, cell sites 104 will typically be distributed so that a contiguous geographic region is covered and serviced completely by the cellular system. In this regard, each cell will be disposed adjacent a number of other cells, or more specifically, will be surrounded by a number of adjacent cells.

The base stations 104 are responsible for setting up and maintaining calls placed to and from subscriber stations 102 in their respective cells. The cell sites 104 "hand-off" to neighboring cell sites as a subscriber moves from cell to cell. They also communicate call progress with the MTSO 106.

The MTSO 106 is a telephone switching system with network connections to cellular base stations 104 and trunk lines 112 to and from the public switched telephone network (PSTN) 116. The PSTN 116, in turn, connects to standard telephones, such as those existing in residential areas or homes. A principal function of the MTSO 106 is to maintain a database of subscribers and subscriber features, track the progress of calls made to or from subscribers, and record call details for billing purposes. Such cellular billing typically varies from subscriber to subscriber, depending on a number of factors, including a particular package that a subscriber has purchased from the cellular provider.

The MTSO 106 is typically configured to execute at least three principal functions. The first is a switched network management function, which manages the

interconnection of subscriber stations 102 and the PSTN 116. The second principal function includes a system control program which provides various functions to maintain a database of subscriber stations. A third principal function of the MTSO 106 is an automated message accounting program, which delivers call records having data for billing purposes.

Having described certain fundamental components in a telecommunications system, reference will now be made to the present invention. As previously mentioned, the present invention relates to a light monitoring system surrounding an ATM. Three different configurations are illustrated in FIG. 1 for communicating light sensor data from an ATM device to a central system 118. Each of these embodiments will be discussed in more detail in connection with FIGS. 2, 3, and 4A.

In a first embodiment, a plurality of sensors 130 are disposed in communication with an ATM 120. The sensors include light level sensors, and may include additional sensors such as sensors for detecting the proper operation of a security camera disposed in connection with the ATM 120. In this first embodiment, a cellular transmitter 102 is also disposed in connection with the ATM 120. The sensor status information is provided to the cellular transmitter, which establishes a communication link via cell site 104, MTSO 106, and PSTN 116 to a central system 118. The central system 118 may include dispatch personnel, which could respond to a condition of low lighting detected by the sensors 130 at the ATM 120 to repair or correct any defective condition sensed. In this regard, the sensors 130 may be configured to, in essence, report a binary state. That is, they may report a first state if the lighting conditions exceed a predetermined minimum threshold, or report a second state if the lighting conditions fail to meet that

minimum threshold. Alternatively, the sensors 130 may be configured to quantify and report a precise level of lighting detected at the sensors 130. This information could be monitored at the central system, and if lighting conditions were detected to be on the decline, then the central system 118 could dispatch a service person to check on or service the lighting system at ATM 120.

In a second embodiment, a plurality of sensors 132 are disposed in connection with an ATM 122. This embodiment may be configured similar to the first embodiment, with the exception that the second embodiment does not utilize a cellular transmitter. Instead, an RF transmitter 126 may be configured in place of the cellular transmitter 102. As will be further described below, the RF transmitter 126 may be configured to communicate data via an RF link to a remote (but nearby) receiver 129. The receiver 129 may be disposed in connection with a phone line interface to further communicate the received data across a land-line telephone (*i.e.*, PSTN 116) to the central system 118.

In a third embodiment, sensors 134 may be disposed in connection with an ATM 124, as in the first two embodiments. However, in the third embodiment, a phone interface 128 is provided within the ATM 124. The phone interface 128 provides a direct interface in connection to a land-line telephone (*i.e.*, the PSTN 116) for communication of data directly via the PSTN 116 to the central system 118.

Each of the embodiments briefly described above will be described in more detail in connection with FIGS. 2, 3, and 4A. It will be appreciated, however, that further variations of these systems may be provided consistent with the present invention. Furthermore, the various embodiments may be collectively configured (as shown in FIG. 1) in a single system, which monitors a plurality of ATMs 120, 122, and 124. It will be

appreciated that the invention provides a robust and economical system for monitoring light levels surrounding automatic teller machines 120, 122, and 124, whereby upon detection of below specified lighting conditions, service and repair personnel may dispatched immediately to rectify the situation. In this way, lighting provided at various banking facilities may be maintained at safe operating levels, thereby minimizing theft, which may otherwise occur around these banking machines.

Reference is now made to FIG. 2 which shows the first embodiment in more detail. In this regard, the ATM environment is illustrated as having a plurality of sensors 130a, 130b, and 130c. More specifically, a plurality of light level sensors or transceivers 130a and 130b are disposed in communication with a computer 121. Although only two light level sensors 130a and 130b have been illustrated, it will be appreciated that many more may be provided consistent with the concepts of the invention. Similarly, additional security camera sensors 130c, or other operational sensors may be provided. Further, it will be appreciated that the computer 121, for purposes of this application, broadly refers to any processing device, such as an electronic circuit including a microprocessor, microcontroller, a specially configured state machine, or other electronic circuit that is configured to process a sequence of instructions. A camera sensor 130c is also disposed in communication with the computer 121. In accordance with the concepts and teachings of the invention, the sensors 130a, 130b, and 130c may be passive components configured to sense a level of light (or operability of a camera) and report that data to the computer 121 via a direct wire connection. In this regard, the computer 121 may have an interface (not shown) that reads the values on the various signal connections 152, 154, and 156. In one embodiment, the signal connections 152, 154, and

156 may be single wire connections that convey binary information (*i.e.*, logic high or logic low) to reflect whether or not the lighting condition detected by the light sensors 130a and 130b exceeds any lighting specifications. Likewise, the signal line 156 may be a binary signal simply indicating whether the camera monitored by the sensor 130c is operable. Alternatively, the signal connections 152, 154, and 156 may be single wire connections that convey analog information that is received at the ATM 120 by an interface (not shown) that converts the analog values carried on the signal lines into digital values that may be read and processed by the computer 121. Analog signals may convey a spectrum of information, most notably an accurate reading of a precise light level sensed by the sensors 130a and 130b.

In yet a further embodiment, the sensors 130a, 130b, and 130c may comprise transceivers that are capable of either transmitting information to the computer 121 or receiving information from the computer 121. In such an embodiment, the signal connections 152, 154, and 156 may comprise a serial interface, a parallel interface, or other interface to appropriately interconnect the sensors 130a, 130b, and 130c with the computer 121. In this embodiment, the computer 121 may periodically request the status of the sensors 130a, 130b, and 130c. This request/response protocol is illustrated in the figure by the designations Ping (computer request for information) and Pong (sensor's response to the request). The computer 121 may periodically request this information on its own initiative and timing, or may be further responding to requests ultimately made by the central system 118. In this regard, the central system 118 may initiate a request for information about the lighting in a particular ATM 120, whereby this request is initiated over the PSTN 116 and is routed through the MTSO 106. The MTSO 106 may then

initiate a call via a cellular link to the cellular transceiver 102 within the ATM 120. The cellular transceiver 102 may then relay this request to the computer 121 which then submits individual requests to the sensors for information. The response (Pong) may then be relayed back through the various links to the central system.

Reference is made now to FIG. 3 which shows an alternative environment for the present invention. In this environment, sensors 134A, 134B, and 134c are provided in connection with an ATM 124. The sensors 134A, 134B, and 134c, and their communication with the computer 161 may be the same as that described in connection with sensors 130a, 130b, and 130c, in computer 121 of FIG. 2, and need not be further described herein. The significant distinction between the environment of FIG. 2 and that of FIG. 3 is that the environment of FIG. 3 communicates directly from the ATM 124 across the PSTN 116 to the central system 118, whereas the environment of FIG. 2 communicate via a cellular link before reaching the PSTN 116. Therefore, in this environment a phone interface 128 is provided in connection with the computer 161 at the ATM 124. This phone interface is designed to interface directly with a telephone line, and thus communicate across the PSTN 116. It is anticipated that this environment will be the most common environment for ATM devices that are provided in connection with a banking facility, and are therefore not subject to move. However, other ATM devices are provided in shopping malls, at restaurants, in grocery stores, and a variety of other facilities where the routing of a telephone line directly to the ATM may not be desirable. In such an environment, the embodiment of FIG. 2 or that of FIG. 4A (which will be discussed below) may be more desirable.

Having said this, reference is now made to FIG. 4A, which shows yet another environment for the present invention. In this environment, sensors 132a, 132b, and 132c, are disposed in communication with a computer 171. Operation of the sensors 132a, 132b, and 132c and a computer 171 will be as described in connection with FIG. 2, and therefore need not be repeated here. The significant difference of the environment of FIG. 4A is that an RF transmitter 126 is provided at the ATM 122 for communicating data to the central system 118. Preferably, the transmitter 126 is a relatively low power RF transmitter that communicates data via an RF link to a nearby receiver 129 that is disposed in connection with a telephone interface, for connection to a telephone line and therefore communication via the PSTN 116. In an alternative embodiment, the RF communication device 126 may be a transceiver capable of bi-directional communication via RF link 173 with a transceiver disposed in communication with a phone interface. This would allow requests from the central system 118 to be made across the PSTN 116 and through the transceiver 126 for status information of the various sensors 132a, 132b, and 132c.

Reference is now made to FIG. 4B which describes the communication of data between the transmitter 126 and the receiver/telephone interface 129. Again, this transmission of data occurs across an RF link 173. In a preferred embodiment, the receiver/telephone interface 129 is disposed internally and in connection with a public, pay-type telephone 180. The particular format and protocol of data transmitted from the transmitter 126 may be as described in co-pending U.S. patent application Serial Number 09/102,178, filed on June 22, 1998. In this regard, the packet of data communicated across the RF link 173 may include certain synchronization bits, certain error detection

and correction bits, and an encoded data word. With regard to the present invention, the encoded data word will preferably convey the status of all the sensors 132a, 132b, and 132c a the ATM location. A computer at the central system 118 may be configured to decode the encoded data word to ascertain the precise value and status of each of the various sensors.

Reference is now made to FIG. 5 which is a flow chart that illustrates the top level operation of a system constructed in accordance with the present invention. In this regard, the system continually monitors light sensors which are configured to detect either a quantization of lighting at a particular location around an ATM device, or, alternatively, to detect whether or not the lighting conditions at a given location exceed certain specified threshold values (step 190). The status of the light sensors is then communicated to the ATM (step 192). The ATM then communicates this sensor status to a central system (step 194). In this regard, this communication step may comprise communication across a cellular link, direct line communication from a telephone interface provided at the ATM, or alternatively an intermediate communication via an RF link to a nearby receiver that then further communicates the data via the PSTN to a central system. If the central system deems that the light level sensed at the various lighting sensors is adequate (*i.e.*, meets or exceeds specification) then it returns to step 190 where it continues the monitoring of a light level sensors. If, however, the central system determines that the light level at the various lighting sensors is inadequate or below specifications, then it may dispatch service personnel to correct the faulted lighted conditions to bring the lighting around the ATM device back up to the specifications, and therefore reduce the possibility of theft or other crime at the ATM site.

Having described various embodiments of the present invention, it will be appreciated that the ATM device is not a limitation on the invention, but simply defines an environment for the preferred embodiment. Accordingly, the concepts and teachings of the invention as described above may be realized in an identical system surrounding some device other than an ATM. It has been illustrated as being disposed within an ATM device purely as a matter of convenience, and should not be viewed as limiting on the invention. Accordingly, additional alternative embodiments of the present invention are set forth in FIGS. 6, 7, and 8. Further, in these additional embodiments, it has been chosen to illustrate the light sensor units in a differing fashion.

Reference is made to FIG. 6 to illustrate one such additional embodiment. In this regard, the light sensors as depicted in the previous embodiments, are replaced with light meter gauges 230a and 230b. As opposed to the passive light sensor components previously described, the light meter gauges 230a and 230b are active components, and indeed are devices that contain onboard intelligence. In this regard, each light meter gauge includes a light sensor 202a (preferably a photo-cell), a processing unit 204a, a memory 206a, and an RF transmitter 208a. The processing unit 204a may be a microprocessor, a microcontroller, or other circuitry configured to control the operation of the light meter gauge 230a, or otherwise execute a sequence of instructions or operations.

The photo-cell 202a is a component that reacts to the intensity of light to generate an output electrical signal that may be supplied to the other components of the light meter gauge. A bus 227a has been illustrated in FIG. 6 as providing a communication link between the various devices on the light meter gauge 230a. It will be appreciated that, in

practice, there will be a number of electrical signal wires interconnecting these devices, including conductors that make up a data bus, an address bus, and a variety of control and signaling conductors as well. Further, it will be appreciated that the output of the photo-cell 202a will typically be an analog value. Therefore, an analog to digital converter (not shown) would necessarily be included in the preferred embodiment in order to convert the analog data value output from the photo-cell 202a into a format suitable to be read by the microprocessor 204a and/or written to memory 206a. Each light meter gauge 230a and 230b can be configured by storing a program in memory 206a, 206b that controls the operation of the microprocessor 204a, 204b.

An important aspect of each of the light meter gauges 230a and 230b relates to the RF transmitter 208a and 208b. These transmitters are the mechanisms through which each of the plurality of light meter gauges 230a and 230b intercommunicate. Although the embodiment of FIG. 6 has been illustrated with just two light meter gauges 230a and 230b, it will be appreciated that, consistent with the concepts in teachings of the present invention, additional light meter gauges may be provided. Preferably, a first light meter gauge 230a will be configured as a master unit. This configuration may be defined by the program set up in memory 206a to control microprocessor 204a. Upon initialization, the master unit may be configured (in a variety of ways) to poll the various slave devices. In one embodiment, each light meter gauge may be configured with a unique identification code that allows the master unit to poll each individual slave device (using the identification codes as addresses) for its current operational status; namely, the status of the photo-cell 202 output. In an alternative configuration, each of the slave light meter gauges may be configured to communicate by a different RF frequency, and the master

light meter gauge may be configured to poll across the various frequencies in order to ascertain the status of the individual slave devices. Fur purposes of the invention, the detailed implementation regarding the communication between the master unit and the various slave devices may be carried out in a variety of ways.

In addition to controlling the communications among the various light meter gauges, the master light meter gauge 230a is configured with a telecommunications interface. In the embodiment of FIG. 6, the telecommunications interface is a PSTN interface 210 that allows the master light meter gauge 230a to communicate with the PSTN 116 via, for example, a standard telephone line hookup.

In operation, the master light meter gauge 230a collects the data from the various slave light meter gauges and relays that information to the central system 218 via the telecommunications interface. This relay of information may be implemented in a variety of manners. In one configuration, the master unit may periodically relay status information of all of the light meter gauges 230a and 230b. As previously mentioned, each light meter gauge may be configured with a unique identification code 219a and 219b, which may be read by the microprocessor 204a and 204b for communication via the RF transmitters 208b of the various slave light meter gauges to the RF transmitter 208a of the master light meter gauge. This information may be assembled in a data packet that, in addition to synchronization, error detection and correction, and other data, may be formatted and sent out over a link established through the PSTN 116. In this regard, each data packet may include an identification code of each light meter gauge along with a data value associated with each identification code. The associated data values may reflect the status of the light meter gauge 230a and 230b, including the

intensity value output from the photo-cell 202a and 202b. In an alternative configuration, and to allow for shorter packet transmissions, the master light meter gauge 230a may be configured to dial up the central system 218 and send out a short packet of data. This short packet of data may simply be a command that indicates a "ok" or an "all clear" message that informs the central system 218 that all light meter gauges at the given location defined by the master unit are in proper working order, and are receiving light at or above a specified intensity level, and therefore no service needs are required. If, however, the light intensity received at any light meter gauge falls below the specified level, then the master unit may configure the message packet to identify the specific light meter gauge (by its identification code) that is below specification, and/or its illumination level.

At the central system 218, it is contemplated that a computer system 220 may be provided to automatically receive incoming calls from the master light meter gauge 230a and interpret the data packet to respond in an automated fashion. FIG. 6 illustrates various factors or data fields or objects that the computer 220 may utilize during operation. Items like a time/date stamp, a location identification, a light meter identification, personnel contact, and other data values or objects may be maintained in records at the central system 218. The location identification may identify a given area that is monitored by a plurality of light meter gauges. The light meter identification may be a data value that identifies an identification code for specific light meter gauges at a given location. An illumination meter data value may simply be the status value (*i.e.*, photo-cell intensity value) that is associated with a given light meter gauge identification code. As previously mentioned, this value may represent the intensity of light incident

upon a particular light meter gauge. This value may be compared against a time/date stamp to determine whether, at any given time, the light meter intensity meets or exceeds a predefined threshold value. Also, a personnel contact data field may be provided. Assuming the central station 218 monitors or receives status information from a variety of monitoring systems dispersed at different geographic regions, the personnel contact may differ. For example, if a failure is detected in a light metering system at a first location, then a first personnel contact may be identified, whereas if a different light metering system failure at a geographically distinct location, a second personnel contact (*i.e.,* service person) may be identified. Likewise, if other sensors are provided (*e.g.*, sensors for detecting failure of a security camera), then a third service personnel may be contacted. The computer 220 may be configured to automatically prompt the service personnel as by e-mail, paging, or otherwise to notify them of the problem and the location of the problem to be corrected.

Reference is now made to FIG. 7, which illustrates a similar, but slightly different embodiment. In this embodiment, the telecommunications interface is a cellular transmitter 230. Consistent with the invention, the cellular transmitter may include a modem and therefore communicate via cellular modem link. Rather than communicating immediately through the PSTN, the cellular link provided by interface 230 communicates via cell site 204 and MTSO 106 in a manner similar to that described in connection with FIG. 1. The various other aspects of FIG. 7 may be configured as described in connection with FIG. 6.

Reference is now made to FIG. 8 which shows yet another embodiment of the present invention, similar to those of FIGS. 6 and 7. Indeed, the embodiment illustrated

may be viewed as operating in the same fashion as that described above, with the exception that the telecommunications interface is an RF interface 240. In this embodiment, the master light gauge 230a may communicate via RF telecommunications link to a nearby RF receiver 129, which includes a PSTN interface for communication with the PSTN 116. As previously described, the RF receiver may be a RF receiver that is disposed in a nearby pay-type telephone.

FIG. 9 illustrates an embodiment similar to FIG. 1, but reflecting the embodiments of FIGS. 6, 7, and 8. Therefore, an overall system may comprise a variety of configurations of master/slave gauges depending upon the location being reported from. Therefore, a first master gauge 302 may be provided to communicate with a plurality of slave gauges 304 and 306 via RF transmission links as described above. This first master gauge 302 may be configured to communicate with a central system 118 via a cellular link 305 to a cell site 104, MTSO 106, and PSTN 116. A second master gauge 308 may be configured to communicate with a plurality of slave gauges 310 and 312 and communicate via RF link 313 to a nearby RF receiver 129 which is interfaced to a standard PSTN telephone line. In yet another location, a master gauge 314 may be configured to communicate via RF links with a plurality of slave gauges 316 and 318, wherein the master gauge 314 includes a PSTN interface 320 to communicate via the PSTN 116 to the central system 118.

By way of clarification, it will be appreciated that the light meter gauges (*e.g.*, 230a and 230b illustrated in FIGS. 6, 7, and 8, may be constructed in a physically similar manner. That is, from a mass-manufactured standpoint, all of the light meter gauges 230a and 230b may be designed to include the telecommunications interface (*e.g.*, cellular

transmitter, PSTN interface, RF interface, *etc.*). However, upon configuration, one of these units may be configured to utilize that interface as a master unit, while the remaining units are configured to operate as slave devices, and therefore not use the interface. It will be appreciated, of course, that this is purely a matter of design choice and economy in manufacture. It will be further appreciated that some of functionality described above may be implemented in the master light meter gauge, or alternatively, may be implemented at the central system. For example, the master light meter gauge may include an onboard clock, whereby it may compare the magnitude of the output from the light sensor (photo-cell) to a given time of day reading, to determine whether the unit is receiving an adequate amount of light. Alternatively, the master unit may be configured simply to periodically transmit this data to the central system, which may be configured to maintain a centralized clock/time of day device.

As shown in FIG. 10, embodiments of the present invention may incorporate a customer access feature so that a customer 402 may be provided with information regarding the lighted ATM area, such as via the Internet 403, among others. Much like the preferred embodiments depicted hereinbefore, the embodiment depicted in FIG. 10 allows information from the various sensors to be communicated to the central system 118 via PSTN 116. The central system 118 is configured to provide the information to a database which is accessible to the customer, preferably through a web site. In this regard, the central system 118 may include a computer that monitors an Internet connection. So configured, customers may access information corresponding to the various sensors by accessing the web site hosted by the central system.

In a preferred embodiment, a selected technician, such as technician 404, may be notified if a failure condition occurs, such as when the light level reading corresponding to any of the ATM sensors falls below a specified level, for instance. The notification may be accomplished via an e-mail message, for instance, and may consist of the location of the light gauges, the light level reading of the light gauges, and an identification code corresponding to the light gauges, among others. The selection of the technician may be selected based on numerous criteria, including whether the technician has a repair contract in place for servicing the customer's ATMs, or whether the technician services the local area in which the customer's ATM resides, among others.

Additionally, when a fault condition is recognized by the central system, the customer may be provided with an alert message. Much like the notification message sent to the technician, the alert message also may include specific information corresponding to the ATM, such as the location of the light gauges, the light level reading of the light gauges, and an identification code corresponding to the light gauges, among others. As an additional feature, for those ATMs which are provided with monitored security cameras, video images produced by the cameras also may be provided to the customer via the Internet web site.

Preferably, the customer access feature is provided by a customer-access monitoring system which can be implemented in hardware, software, firmware, or a combination thereof. In a preferred embodiment, however, the customer-access monitoring system is implemented as a software package, which can be adaptable to run on different platforms and operating systems as shall be described further herein.

A preferred embodiment of the customer-access monitoring system, which comprises an ordered listing of executable instructions for implementing logical functions, can be embodied in any computer-readable medium for use by or in connection with an instruction execution system, apparatus, or device, such as a computer-based system, processor-containing system, or other system that can fetch the instructions from the instruction execution system, apparatus, or device, and execute the instructions. In the context of this document, a "computer-readable medium" can be any means that can contain, store, communicate, propagate or transport the program for use by or in connection with the instruction execution system, apparatus, or device. The computer readable medium can be, for example, but not limited to, an electronic, magnetic, optical, electro-magnetic, infrared, or semi-conductor system, apparatus, device, or propagation medium. More specific examples (a nonexhaustive list) of the computer-readable medium would include the following: an electrical connection (electronic) having one or more wires, a portable computer diskette (magnetic), a random access memory (RAM) (magnetic), a read-only memory (ROM) (magnetic), an erasable, programmable, read-only memory (EPROM or Flash memory) (magnetic), an optical fiber (optical), and a portable compact disk read-only memory (CDROM) (optical). Note that the computer-readable medium could even be paper or another suitable medium upon which the program is printed, as the program can be electronically captured, via for instance, optical scanning of the paper or other medium, then compiled, interpreted, or otherwise processed in a suitable manner, if necessary, and then stored in a computer memory.

FIG. 11 illustrates a typical computer or processor-based system 406 which may utilize the customer-access monitoring system 408. As shown in FIG. 11, a computer

system 406 generally comprises a processor 410 and a memory 412 with an operating system 414. Herein, the memory 412 may be any combination of volatile and nonvolatile memory elements, such as random access memory or read only memory. The processor 410 accepts instructions and data from memory 412 over a local interface 416, such as a bus(es). The system also includes an input device(s) 418 and an output device(s) 420. Examples of input devices may include, but are not limited to a serial port, a scanner, or a local access network connection. Examples of output devices may include, but are not limited to, a video display, a Universal Serial Bus, or a printer port. Generally, this system may run any of a number of different platforms and operating systems, including, but not limited to, Windows NT™, Unix™, or Sun Solaris™ operating systems. The customer accessible monitoring system of the present invention resides in memory 412 and is executed by the processor 410.

As shown in FIG. 12, the customer-access monitoring system 408 can be adapted to provide a customer with access to ATM status information. For instance, customer 402 may access ATM status information by accessing a web site established by the central system 118 via the Internet 403, as previously described. Information provided at the web site is controlled by the central system 118 and typically is stored in a database 422 which is accessed by the monitoring system 408 of the central system computer 406. Likewise, ATM status information may be provided to technician 404, such as in the form of a notification message, as previously described, via the Internet 403.

In the embodiment depicted in FIG. 12, the customer-access monitoring system 408 also can be adapted to provide a customer with direct access to ATM status information. Embodiments of the present invention so adapted may effectively remove

the central system 118 from the monitoring process and may be preferred depending upon the particular application. As depicted in FIG. 12, customer 424 is able to communicate directly with various ATMs via the PSTN 116, thus allowing the customer to query the various ATMs regarding status information. For instance, once the monitoring system 408 has been installed on the customer's computer systems 406, the monitoring system allows the customer 424 to access ATM information by communicating directly with the ATMs. The customer may make status queries which are communicated to the ATMs, such as to the CPUs of the respective ATMs. In response to these queries, the CPUs, such as the CPUs of a master gauges, for instance, provide the requested information directly to the customer.

Alternatively, the monitoring system may be established to receive periodic updates of status information from the ATMs, thereby allowing a customer to receive the most recent status information communicated to the monitoring system without the necessity of a customer-prompted query. The monitoring system also may incorporate an auto-alert feature, whereby the monitoring system informs the customer via a prompt or other suitable alarm that a failure condition at a monitored site has occurred. Additionally, the monitoring system may forward a notification message to a technician, as previously described.

Similarly, the customer-access monitoring system 408 can be adapted to provide technicians with direct access to ATM status information. For instance, as depicted in FIG. 12, technician 430 is able to communicate directly with various ATMs via the PSTN 116, thus allowing the technician to query the various ATMs regarding status information.

Additionally, some embodiments may allow a customer to receive status information through network 428 (i.e., a LAN), whereby the central system maintains the information in a database as previously described, and then allows the customer, such as customer 432, to access the information stored in the database via the network. In a similar manner, technician 434 also may access or receive information relating to the ATMs.

The foregoing description is focused on one embodiment of the present invention in an area surrounding an ATM. However, alternative embodiments of the present invention monitors other types of areas. The other types of areas include but are not limited to parking lots or facilities, buildings, residences, underground facilities, and streets. FIG. 13 is similar to FIG. 10 except that FIG. 10 shows an alternative embodiment of the present invention in areas surrounding ATMs while FIG. 13 shows an alternative embodiment of the present invention in lighted areas.

In another alternative embodiment of the present invention shown in FIG. 14, information that a sensor senses is transmitted from one lighted area to another lighted area until it reaches a lighted area with a phone interface that communicates the information to the central system via the PSTN. A customer or a technician or any other person has access to the central system via the Internet. Particularly, a transceiver 126 in the lighted area 122 communicates the information that sensors 132 sense, to the lighted area 120. The transceiver 102 in the lighted area 120 receives the information and communicates that information to another lighted area 124. The transceiver 140 in the lighted area 124 receives that information and stores it in the phone interface. The phone interface 128 in the lighted area 124 communicates that information to the PSTN 116 that

further communicates the information to the central system 118. A customer 402 or a technician 404 can access the information in the central system via the Internet 403. Hence, in this alternative embodiment of the present invention, information is relayed from one transceiver to another until it is communicated to the central system 118 that provides access to the customer or the technician via the internet 403.

Figure 15 depicts another alternative embodiment of the present invention. In general, in FIG. 15, the transceivers communicate with each other thereby creating an RF cloud 167 that the transceivers can then use to directly communicate information to the central system via a gateway. Particularly, the transceiver 126 relays information to the transceiver 102 that further relays to the transceiver 140. The relay creates a cloud 167. Any transceiver, 126, 102, or 140 can use the cloud to communicate information to the central system 118 via a gateway 166. A gateway, as known by people having ordinary skill in the art, facilitates a communication of information between systems that use incompatible protocols. The customer 402 or the technician 404 can access the information in the central system 118 via the Internet 403. Hence, in FIG 15. a communication between the transceivers creates a cloud that allows any of the transceivers to communicate to a central system via a gateway.

Lastly, FIG. 16 depicts another alternative embodiment of the present invention. In this figure, a transceiver at a remote lighted area uses the cloud to communicate information to the central system via the gateway. Specifically, there is a lighted area 171 that is remote to the lighted areas 122, 120 and 124. The sensors 170, sense the level of light near the remote lighted area 171. The transceiver 169 then communicates with the central system 118 via the gateway 166, using the cloud 167. This eliminates the

need of an extra gateway since the transceiver 169 uses the same gateway that the cloud 167 uses to communicate with the central system 118.

For instance, the transceivers in a parking lot may relay information about the level of light at the light poles located in the parking lot, thereby creating a cloud. Another transceiver, remotely located (*e.g.* near a house) can use the cloud to communicate a utility meter reading to the central system via the same gateway that the cloud uses to communicate to the central system. Thereafter, a customer or a technician can access the information in the central system via the Internet.

The foregoing description has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiment or embodiments discussed were chosen and described to provide the best illustration of the principles of the invention and its practical application to thereby enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly and legally entitled.